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Bibayan

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[54] **SYSTEM FOR MANAGING EXTERNAL APPLICATIONS AND FILES**

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[51] **Int. Cl.**[6] **G06F 9/46**

[52] **U.S. Cl.** **709/302**; 707/205

[58] **Field of Search** 395/700, 680, 395/682; 707/205

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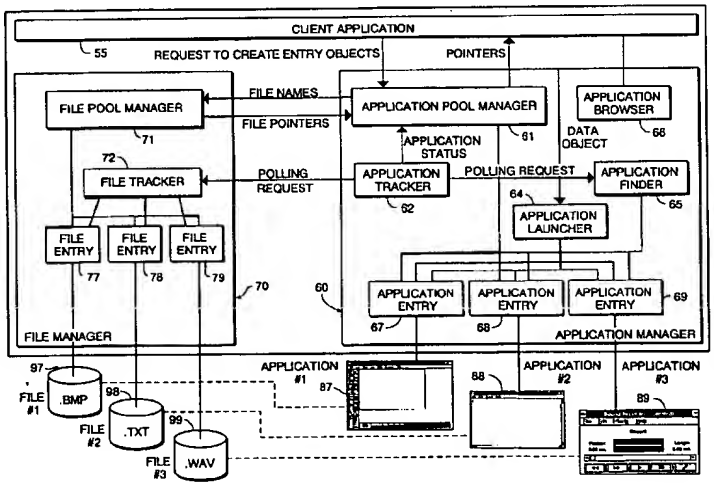
[57] **ABSTRACT**

A computer-implemented system for managing an external application in response to a user's selection of an item in a compound document which is displayed by a client application. The managing system includes an application manager and a file manager which are simple in construction because there is no need for them to communicate directly with the external application; rather, they simply monitor the external application. In response to user selection of an item in the compound document, the client application copies the selected item to an external temporary file and sends the temporary file name to the application manager. Based on the file name, the application manager associates an external application to the file, launches the external application, issues polling requests for activity of the external application, and outputs the file name to the file manager. In response to outputting of the file name from the application manager, the file manager commences monitoring activities of the external file to determine whether it has been modified, and, in addition, returns a pointer for the external file to the application manager. The application manager returns the pointer for the external file to the client application, and in addition returns a pointer for the external application. Upon receipt of these pointers, the client application instructs a windowing operating system to display a window for the external application. By virtue of this arrangement, a full-featured compound document capability is provided in which it is possible to perform all conventional windowing tasks such as close down or re-focus of external applications, and close down or iconization of the client application, all without any specialized communication to the external application or the external file.

46 Claims, 11 Drawing Sheets



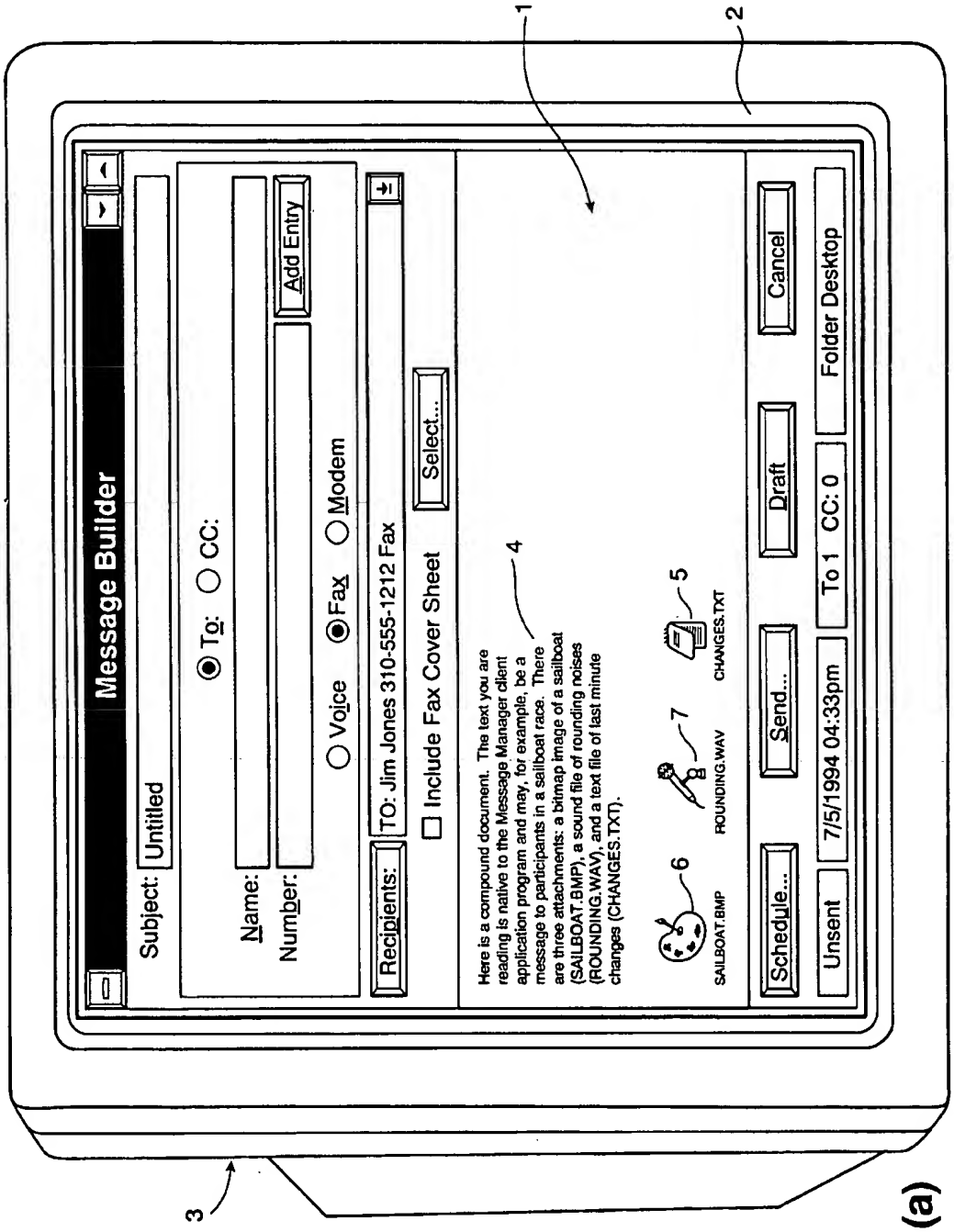

Message Builder
Subject: Untitled
To: CC:
Name:
Number:
Add Entry
Voice Fax Modem
Recipients:
TO: Jim Jones 310-555-1212 Fax
Include Fax Cover Sheet
Select...
Here is a compound document. The text you are reading is native to the Message Manager client application program and may, for example, be a message to participants in a sailboat race. There are three attachments: a bitmap image of a sailboat (SAILBOAT.BMP), a sound file of rounding noises (ROUNDING.WAV), and a text file of last minute changes (CHANGES.TXT).
SAILBOAT.BMP
ROUNDING.WAV
CHANGES.TXT
Schedule...
Send...
Draft
Cancel
Unsent
7/5/1994 04:33pm
To 1 CC: 0
Folder Desktop
1
2
3
4
5
6
7

FIG. 1(a)

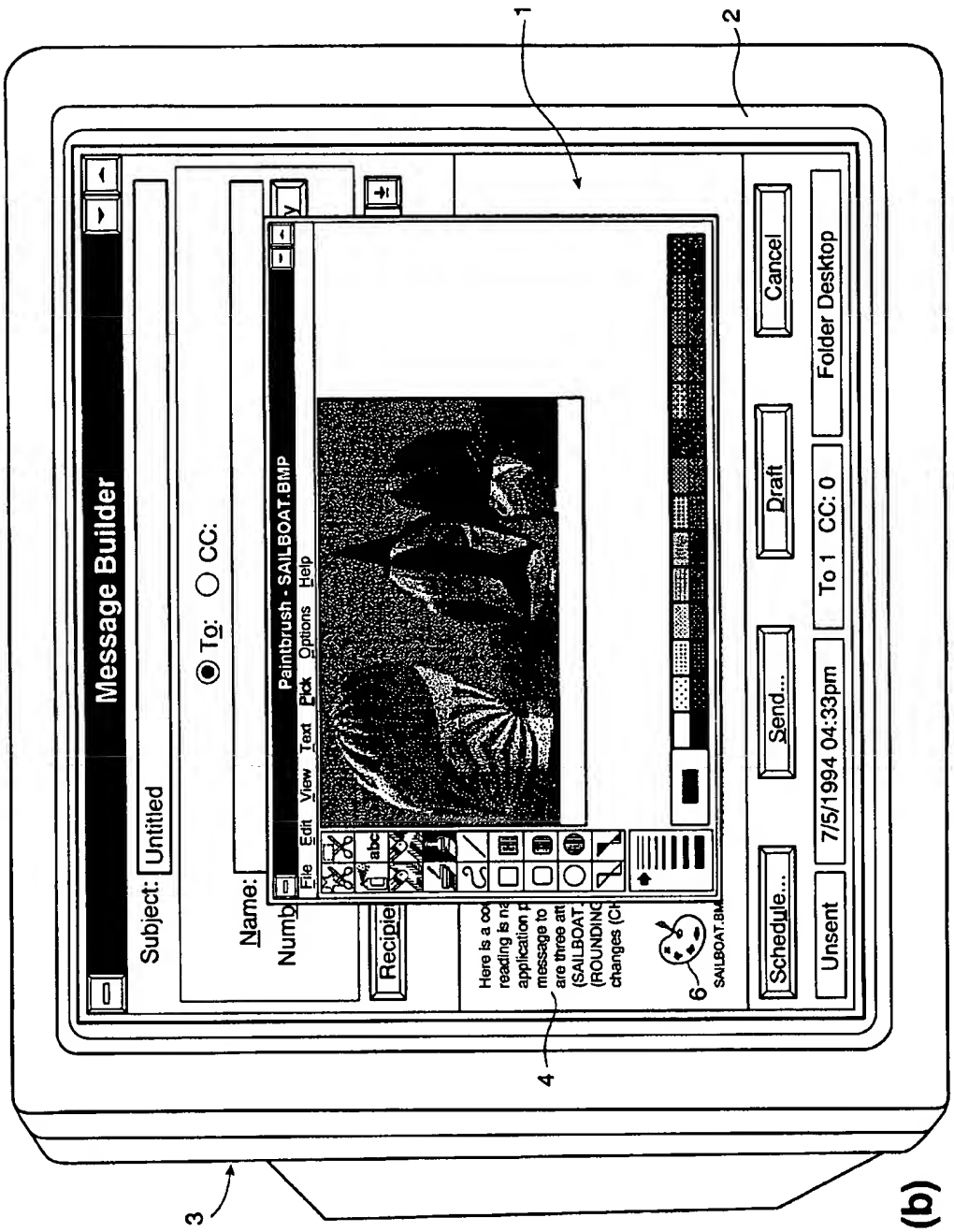

1
2
3
4
6
Message Builder
Subject: Untitled
To: CC:
Name:
Paintbrush - SAILBOAT.BMP
File Edit View Text Pick Options Help
Cancel
Draft
Send...
Schedule...
Folder Desktop
Unsent
7/5/1994 04:33pm
To 1 CC: 0
SAILBOAT.BM

FIG. 1(b)

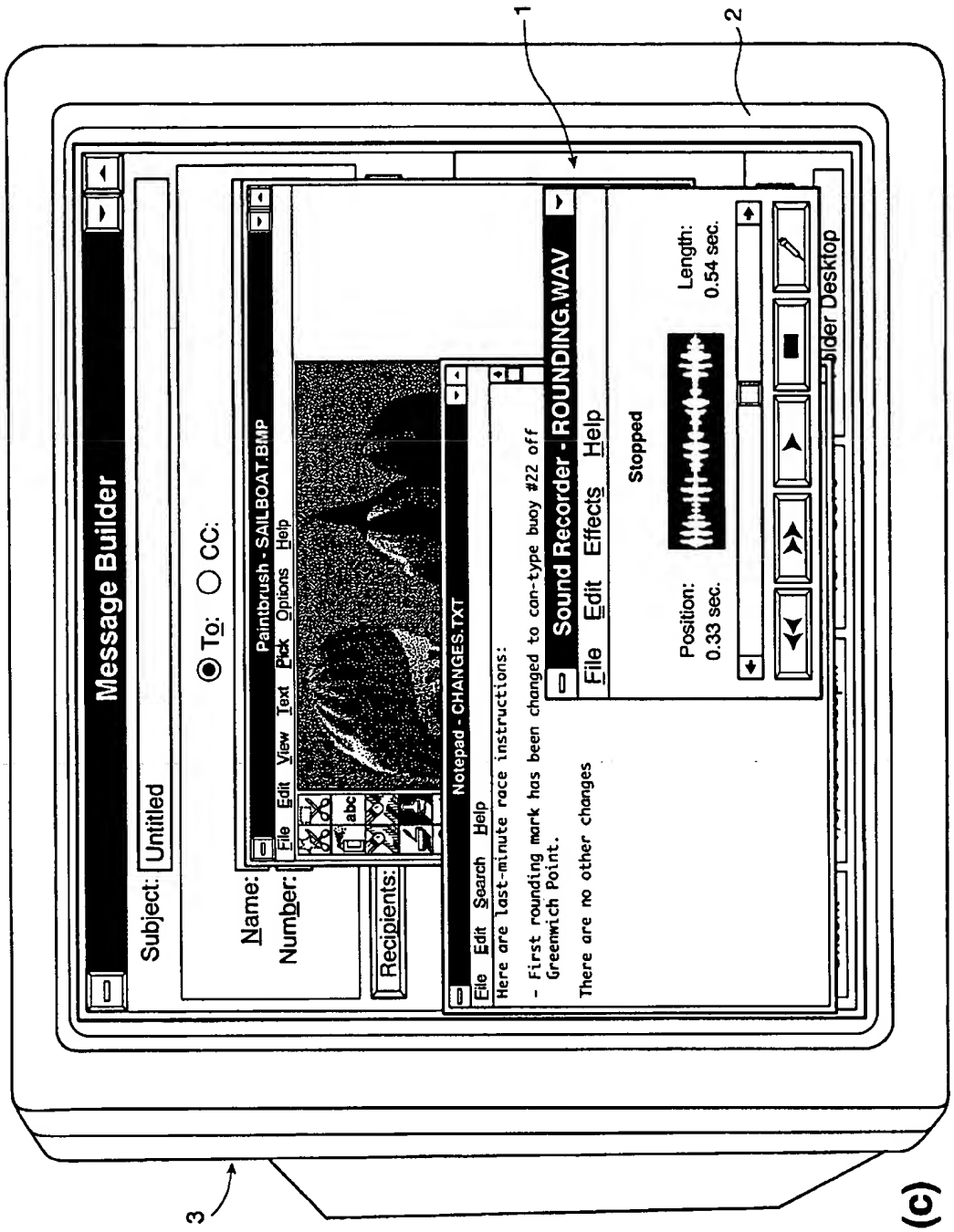

1
2
3
Message Builder
Subject: Untitled
To: CC:
Name:
Number:
Recipients:
Paintbrush - SAILBOAT.BMP
File Edit View Text Pick Options Help
Notepad - CHANGES.TXT
File Edit Search Help
Here are last-minute race instructions:
- First rounding mark has been changed to con-type buoy #22 off Greenwich Point.
There are no other changes
Sound Recorder - ROUNDING.WAV
File Edit Effects Help
Stopped
Position: 0.33 sec.
Length: 0.54 sec.
Desktop

FIG. 1(c)

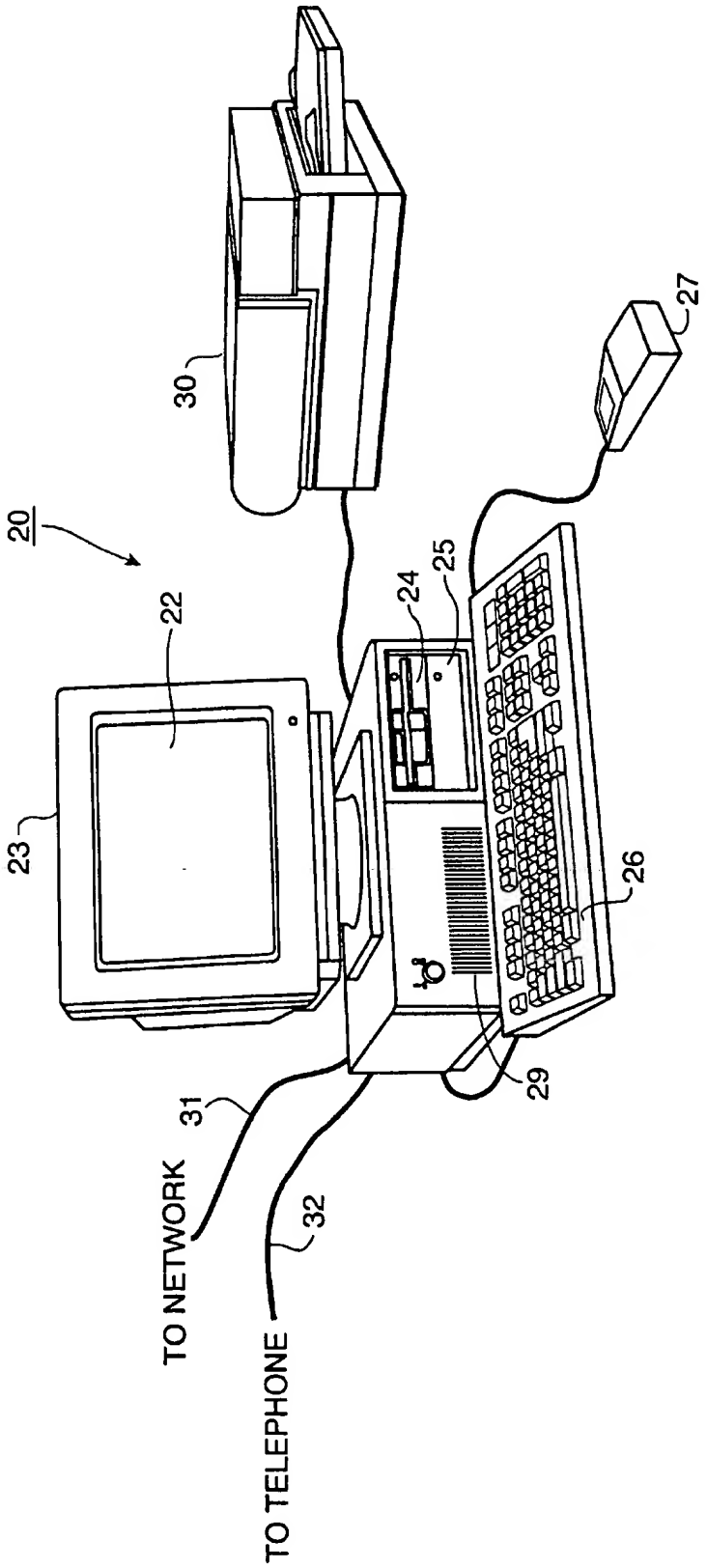


FIG. 2

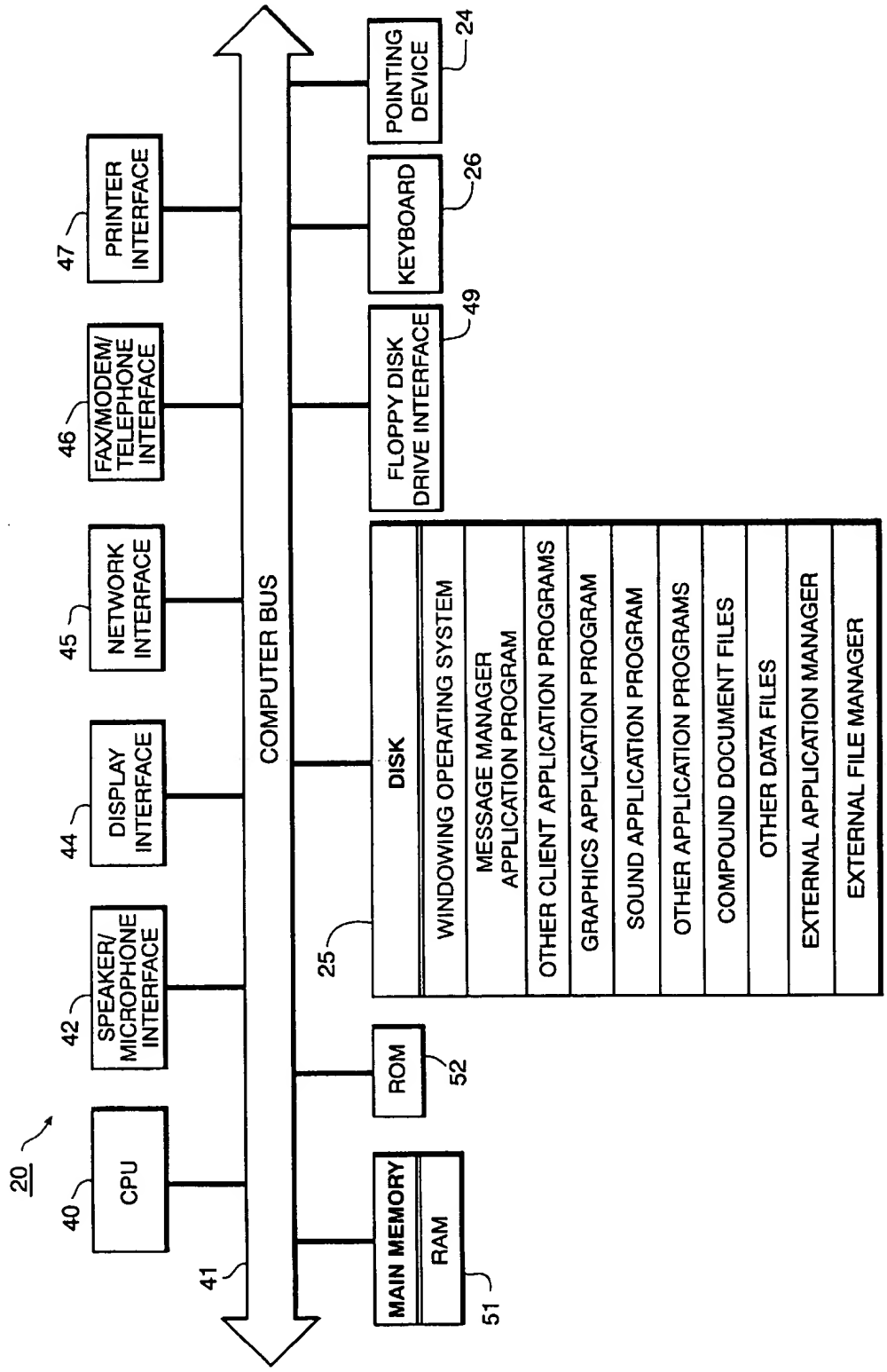

20
40
CPU
41
COMPUTER BUS
42
SPEAKER/ MICROPHONE INTERFACE
44
DISPLAY INTERFACE
45
NETWORK INTERFACE
46
FAX/MODEM/ TELEPHONE INTERFACE
47
PRINTER INTERFACE
MAIN MEMORY
RAM
51
ROM
52
25
DISK
WINDOWING OPERATING SYSTEM
MESSAGE MANAGER APPLICATION PROGRAM
OTHER CLIENT APPLICATION PROGRAMS
GRAPHICS APPLICATION PROGRAM
SOUND APPLICATION PROGRAM
OTHER APPLICATION PROGRAMS
COMPOUND DOCUMENT FILES
OTHER DATA FILES
EXTERNAL APPLICATION MANAGER
EXTERNAL FILE MANAGER
FLOPPY DISK DRIVE INTERFACE
49
KEYBOARD
26
POINTING DEVICE
24

FIG. 3

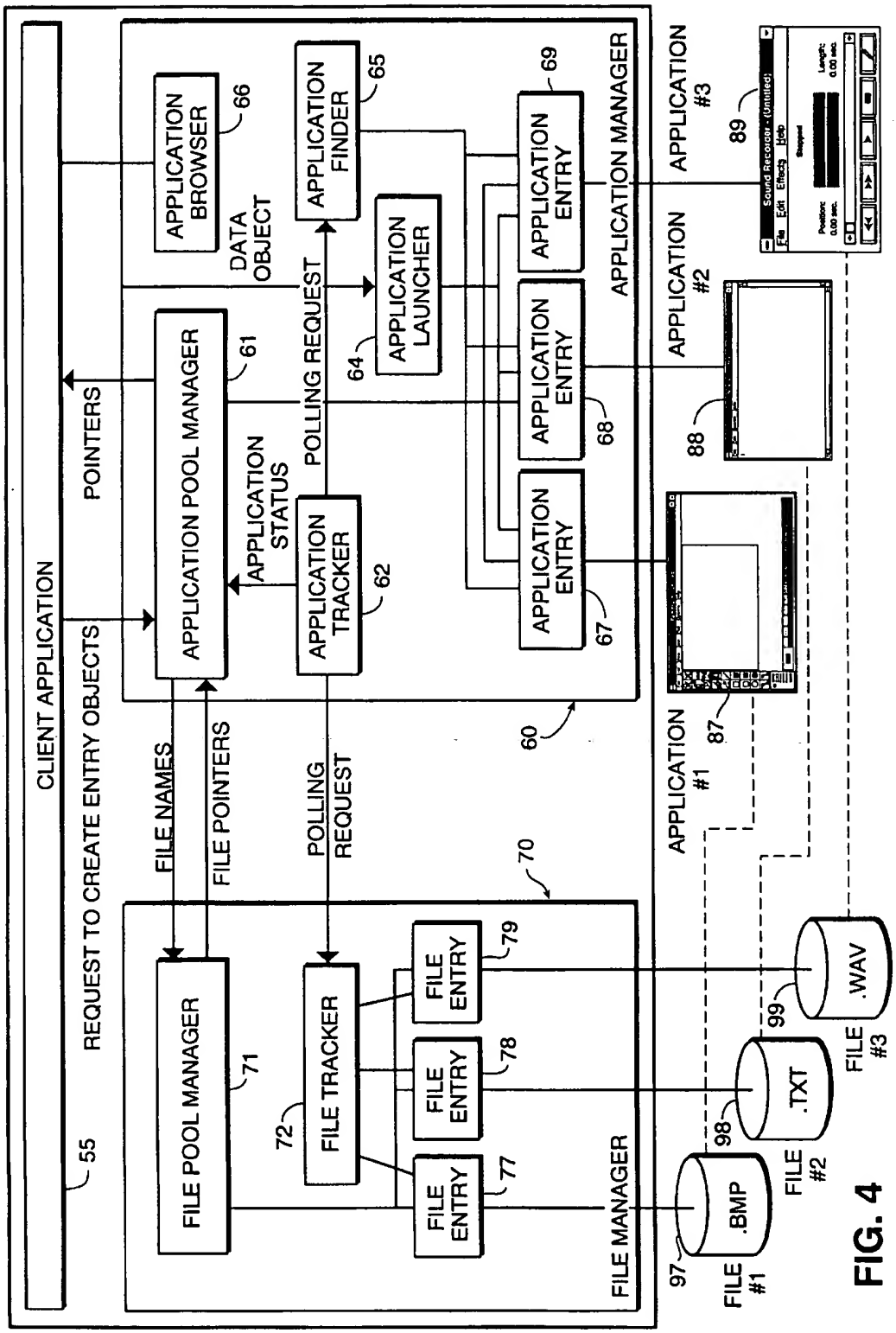

CLIENT APPLICATION
55
REQUEST TO CREATE ENTRY OBJECTS
POINTERS
APPLICATION BROWSER
66
DATA OBJECT
APPLICATION FINDER
65
APPLICATION LAUNCHER
64
APPLICATION POOL MANAGER
61
APPLICATION STATUS
POLLING REQUEST
APPLICATION TRACKER
62
APPLICATION ENTRY
69
APPLICATION ENTRY
68
APPLICATION ENTRY
67
APPLICATION MANAGER
60
APPLICATION #3
89
APPLICATION #2
88
APPLICATION #1
87
FILE NAMES
FILE POINTERS
POLLING REQUEST
70
FILE POOL MANAGER
71
FILE TRACKER
72
FILE ENTRY
79
FILE ENTRY
78
FILE ENTRY
77
FILE MANAGER
.WAV
99
FILE #3
.TXT
98
FILE #2
.BMP
97
FILE #1

FIG. 4

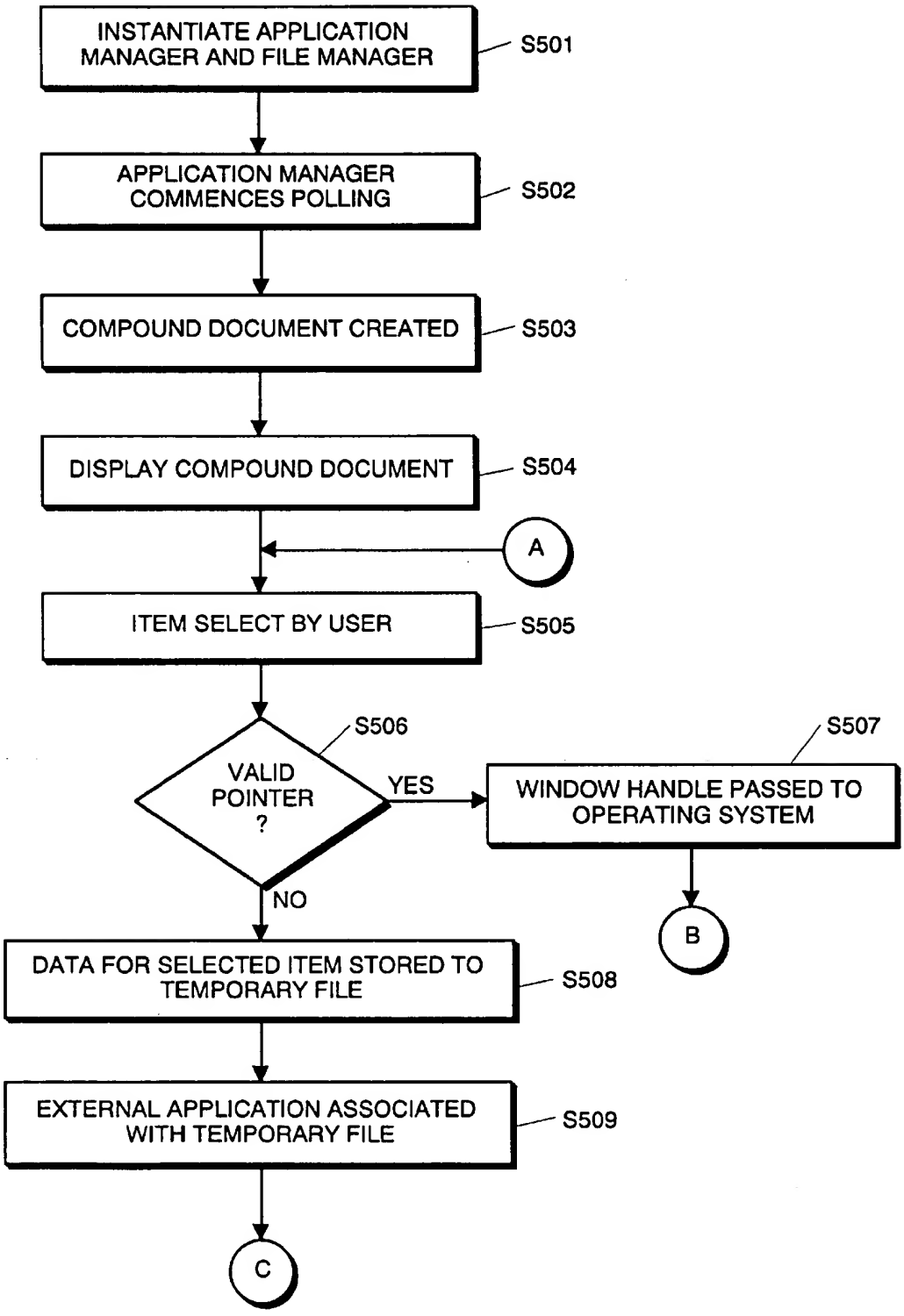

INSTANTIATE APPLICATION MANAGER AND FILE MANAGER
S501
APPLICATION MANAGER COMMENCES POLLING
S502
COMPOUND DOCUMENT CREATED
S503
DISPLAY COMPOUND DOCUMENT
S504
A
ITEM SELECT BY USER
S505
S506
VALID POINTER ?
YES
S507
WINDOW HANDLE PASSED TO OPERATING SYSTEM
B
NO
DATA FOR SELECTED ITEM STORED TO TEMPORARY FILE
S508
EXTERNAL APPLICATION ASSOCIATED WITH TEMPORARY FILE
S509
C

FIG. 5(a)

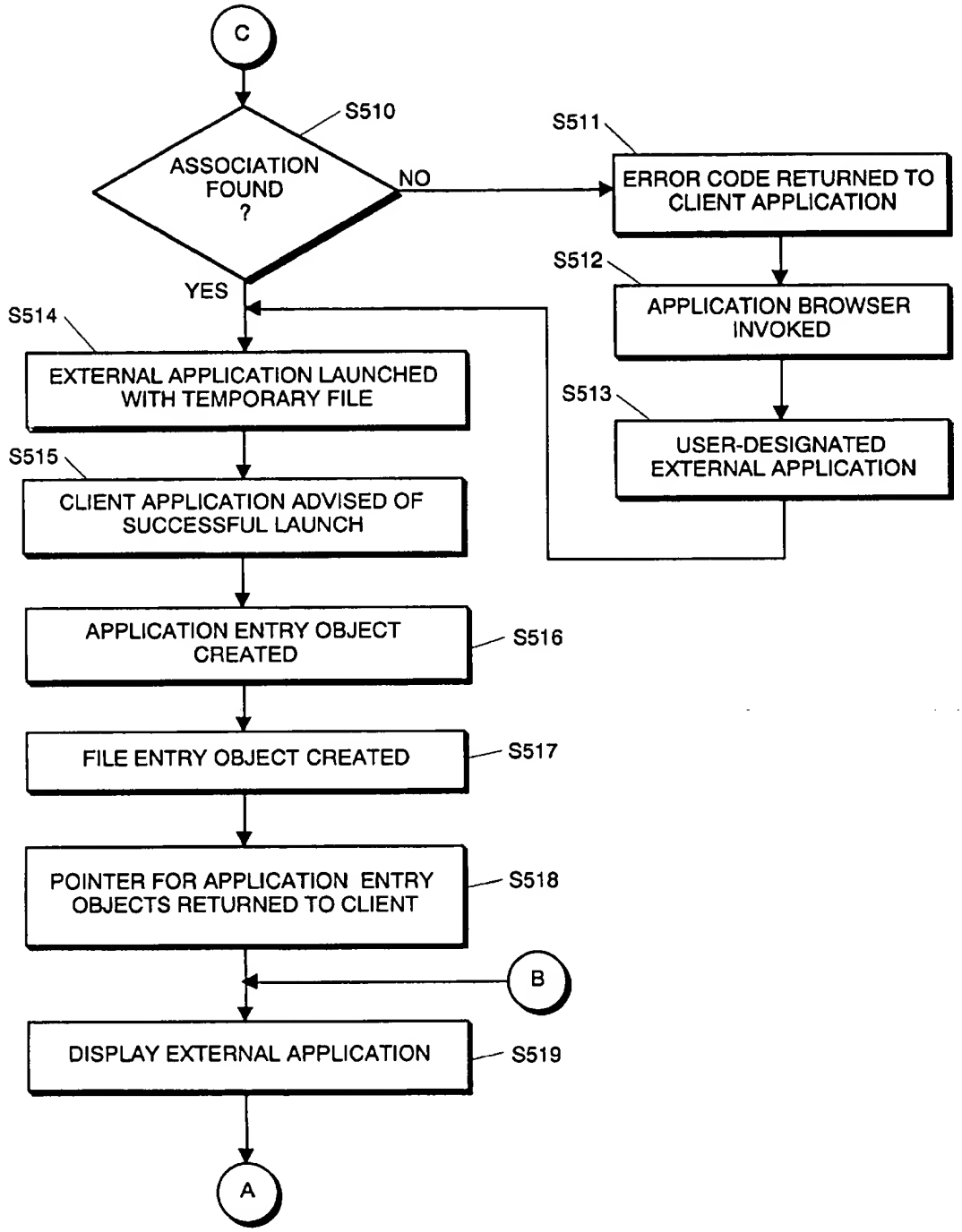

C
S510
ASSOCIATION FOUND ?
NO
S511
ERROR CODE RETURNED TO CLIENT APPLICATION
S512
APPLICATION BROWSER INVOKED
S513
USER-DESIGNATED EXTERNAL APPLICATION
YES
S514
EXTERNAL APPLICATION LAUNCHED WITH TEMPORARY FILE
S515
CLIENT APPLICATION ADVISED OF SUCCESSFUL LAUNCH
APPLICATION ENTRY OBJECT CREATED
S516
FILE ENTRY OBJECT CREATED
S517
POINTER FOR APPLICATION ENTRY OBJECTS RETURNED TO CLIENT
S518
B
DISPLAY EXTERNAL APPLICATION
S519
A

FIG. 5(b)

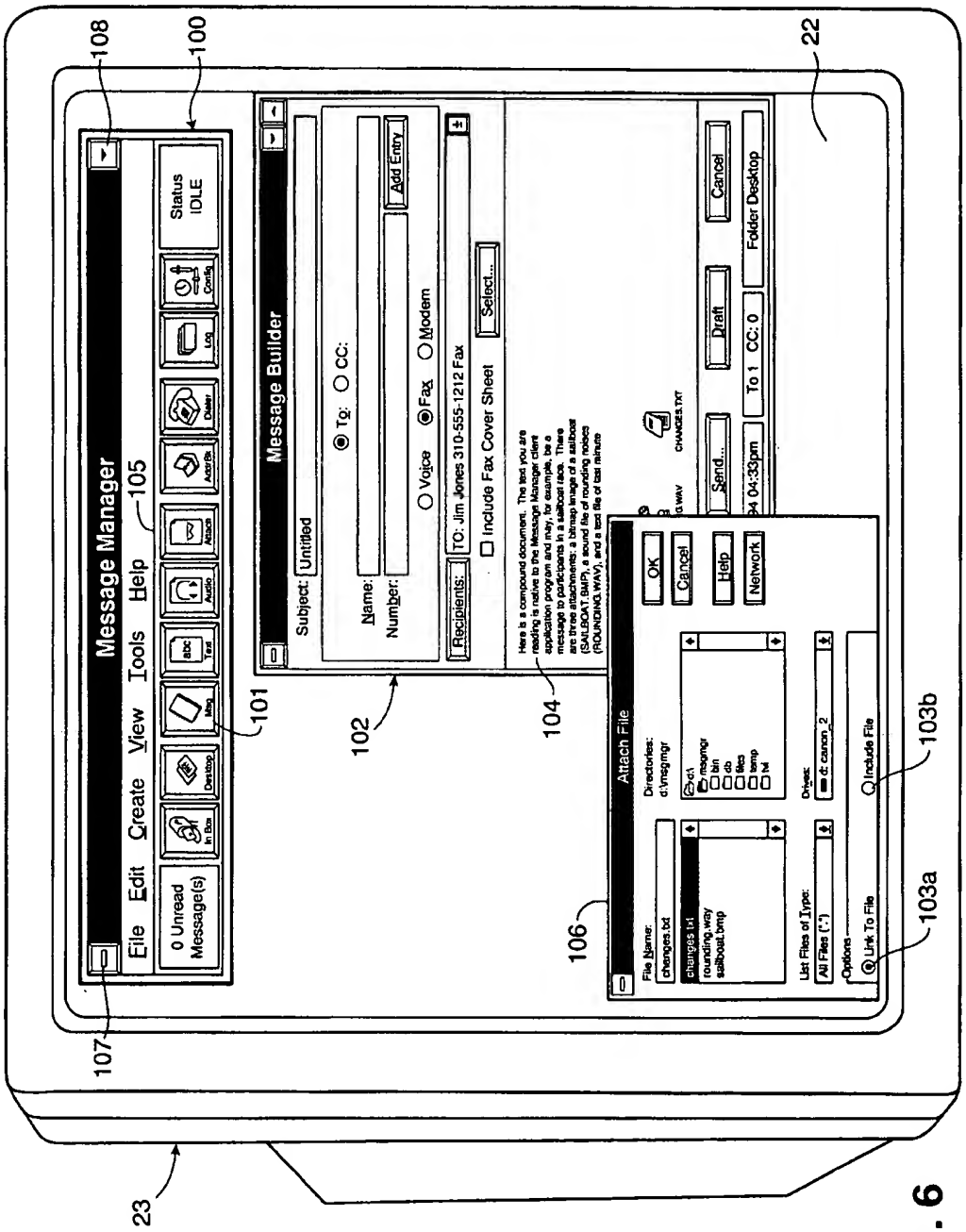

108
100
22
Message Manager
File Edit Create View Tools Help
0 Unread Message(s)
Status IDLE
105
101
Message Builder
Subject: Untitled
To: CC:
Name:
Number:
Add Entry
Voice Fax Modem
Recipients:
TO: Jim Jones 310-555-1212 Fax
Include Fax Cover Sheet
Select...
102
104
Send...
Draft
Cancel
04:33pm
To 1 CC: 0
Folder Desktop
Attach File
OK
Cancel
Help
Network
106
103b
103a
107
23

FIG. 6

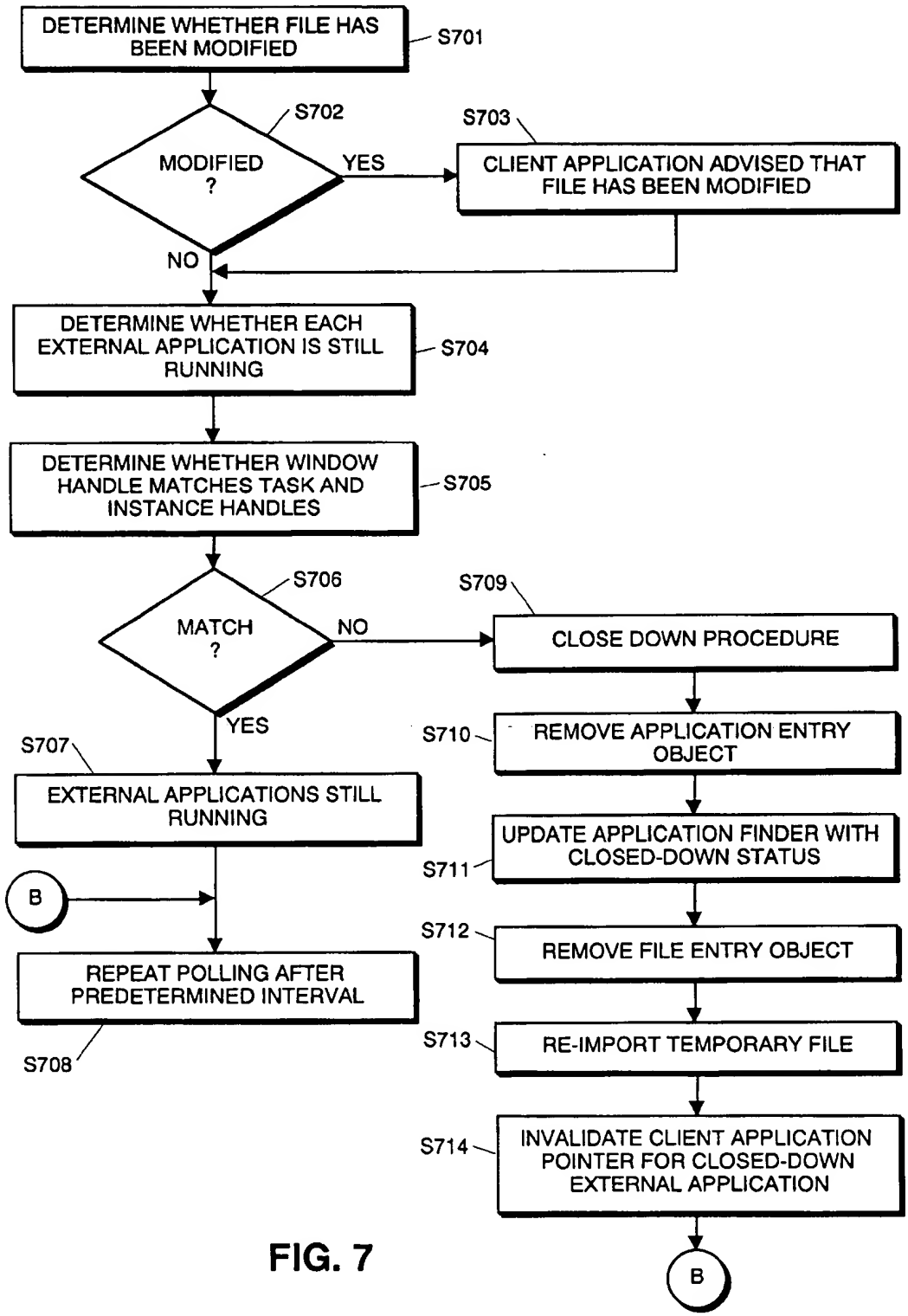

DETERMINE WHETHER FILE HAS BEEN MODIFIED
S701
S702
MODIFIED ?
YES
S703
CLIENT APPLICATION ADVISED THAT FILE HAS BEEN MODIFIED
NO
DETERMINE WHETHER EACH EXTERNAL APPLICATION IS STILL RUNNING
S704
DETERMINE WHETHER WINDOW HANDLE MATCHES TASK AND INSTANCE HANDLES
S705
S706
MATCH ?
NO
S709
CLOSE DOWN PROCEDURE
YES
S707
EXTERNAL APPLICATIONS STILL RUNNING
S710
REMOVE APPLICATION ENTRY OBJECT
UPDATE APPLICATION FINDER WITH CLOSED-DOWN STATUS
S711
B
S712
REMOVE FILE ENTRY OBJECT
REPEAT POLLING AFTER PREDETERMINED INTERVAL
S713
RE-IMPORT TEMPORARY FILE
S708
S714
INVALIDATE CLIENT APPLICATION POINTER FOR CLOSED-DOWN EXTERNAL APPLICATION
B

FIG. 7

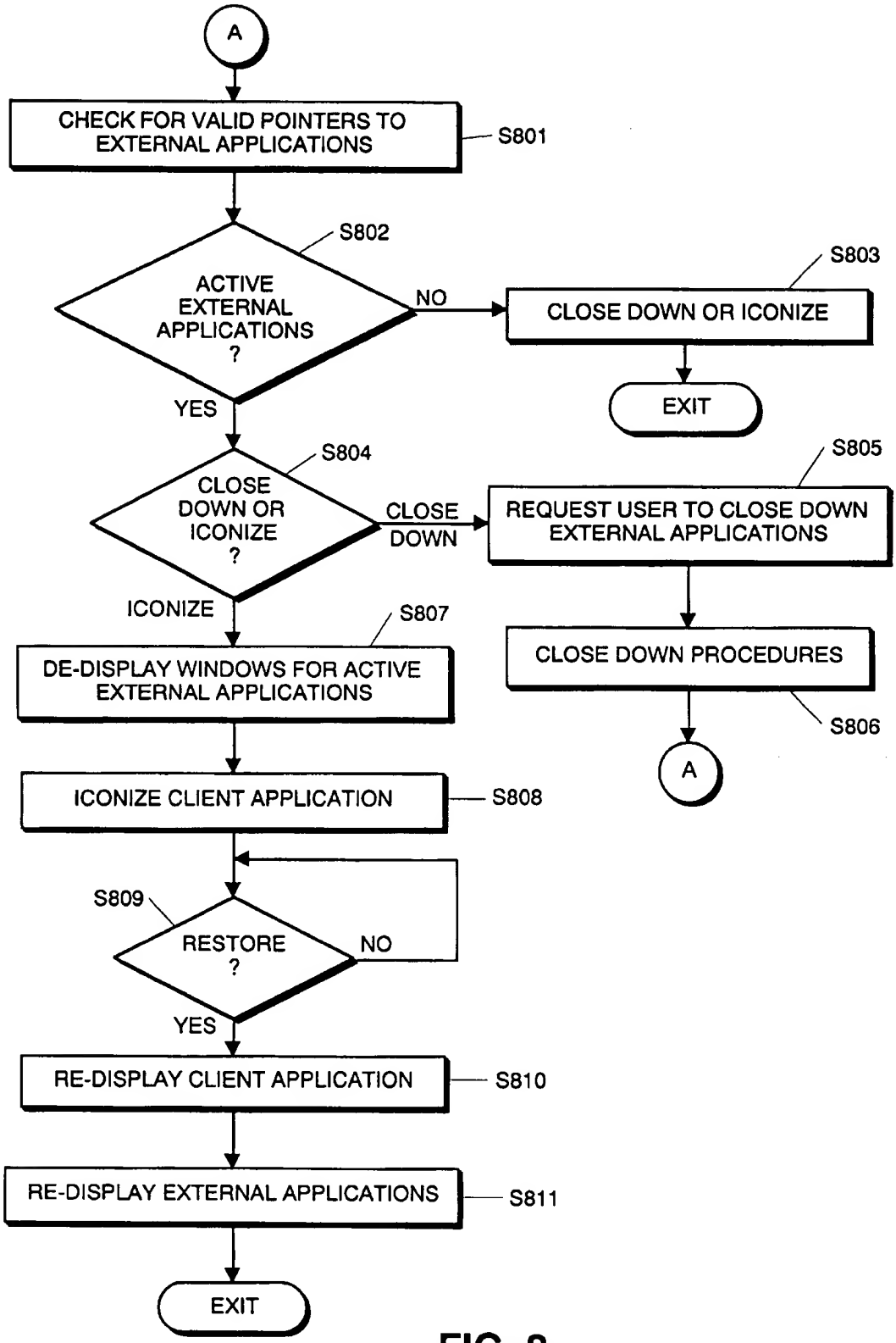

A
CHECK FOR VALID POINTERS TO EXTERNAL APPLICATIONS
S801
S802
ACTIVE EXTERNAL APPLICATIONS ?
NO
S803
CLOSE DOWN OR ICONIZE
EXIT
YES
S804
CLOSE DOWN OR ICONIZE ?
CLOSE DOWN
S805
REQUEST USER TO CLOSE DOWN EXTERNAL APPLICATIONS
ICONIZE
S807
DE-DISPLAY WINDOWS FOR ACTIVE EXTERNAL APPLICATIONS
CLOSE DOWN PROCEDURES
S806
A
ICONIZE CLIENT APPLICATION
S808
S809
RESTORE ?
NO
YES
RE-DISPLAY CLIENT APPLICATION
S810
RE-DISPLAY EXTERNAL APPLICATIONS
S811
EXIT

FIG. 8

SYSTEM FOR MANAGING EXTERNAL APPLICATIONS AND FILES

BACKGROUND OF THE INVENTION

1. Field Of The Invention

The present invention is a computer-implemented management system which works in conjunction with a client application program so as to manage external application programs and their associated files. More particularly, the management system of the present invention provides a system for a client application to launch, track and otherwise manage an external application and its associated file.

2. Description Of The Related Art

It has recently become possible to create a computer document which contains data from a variety of different application programs Such a document is called a "compound document". Compound, documents are created by a first application program, usually called a "client application", and contain one or more data objects from other application programs. A compound document might, for example, be created by a word processing application program. In this case, the compound document contains not only text data native to the word processing application program, but also contains data objects from other application programs such as a bit map data object from a graphics display program, a spreadsheet data object from a spreadsheet program, or a sound data object from a sound recorder application program.

Compound documents are an important development in computer systems because they eliminate the constraint that data in a document must be that one single type of data supported by the client application. With compound documents, it is now possible to create a word processing document that includes not only text from the word processing application but which also includes numbers from a spreadsheet application, images from a graphics application, and sounds from a recorder application.

FIGS. 1(*a*) through 1(*c*) illustrate how a compound document might appear to a user of a client application program, here a client application program which allows a user to send and to receive multimedia messages which may include attachments from external application programs. A suitable client application program for sending and receiving multimedia messages is described in detail in application Ser. No. 07/808,757, filed Dec. 17, 1991, now abandoned, the contents of which are incorporated herein by reference.

In FIG. 1(*a*), a compound document **1** is shown as it might be displayed to a user on display screen **2** of computer monitor **3**. Compound document **1** is a message that is scheduled to be sent to a remote recipient. The compound document includes a text portion **4** which is data native to the client message manager application program. In addition, compound document **1** includes attachments signified by icons **5**, **6** and **7** which are data objects from external application programs. Specifically, text attachment **5** is a simple text file created by an external text editor application such as Microsoft Note Pad. Bitmap attachment **6** is a bitmap file created by an external graphics program such as Microsoft Paint Brush. Sound attachment **7** is a wave file created by an external sound application program such as Microsoft Sound Recorder.

By selecting one of the icons in compound document **1**, such as by double clicking on the icon with a mouse, the user can cause the external application which created the data object to be launched so as to view, edit or otherwise modify the data object associated with the icon. Thus, as shown in FIG. 1(*b*), after selecting the bitmap icon **6**, the external Paint Brush application program is launched so as to display the bitmap attachment. Likewise, in FIG. 1(*c*), the user has selected the remaining icons so as to cause associated external application programs to be launched.

. Various implementations have been proposed so as to allow an external application to be launched from a client application which is displaying a compound document. For example, Microsoft has introduced object linking and embedding (hereinafter "OLE") which allows data objects from external applications to be linked or embedded in a compound document for a client application OLE is described in detail in Chapter 9 of F. Davis, "The Windows 3.1 Bible", Peachpit Press, 1993, the contents of which are incorporated herein by reference. OLE provides a robust implementation of compound documents which allows a user to launch external applications, to switch from one application to another, and to monitor how objects in the compound document are being modified by their respective external applications. However, to achieve this implementation, specialized communication is needed between the external application and the client application. For example, the external application must be OLE-aware and must register itself into a "registration database". The client application must, in addition, be OLE-compliant, meaning that the client application must be able to communicate directly or indirectly to the external applications so as to determine whether they are present must support the creation of complex compound documents, and must also conform to standard OLE interfaces.

Other implementations of compound documents have been proposed, but these implementations constrain how a user is able to manipulate data objects in the compound document. For example, "CC Mail" from Lotus, which is an E-mail client application, provides a compound document capability which is simpler than Microsoft's OLE but which does not provide as many features as OLE. For example, when an external application is launched from the "CC Mail" client application, a user is not permitted to access any other application program until the external application has been closed down. This limits the usefulness of compound documents. For example, when using the client "CC Mail" a application program, the user would not be able to obtain the display in FIG. 1(*c*). Rather, the user would be constrained to the display shown in FIG. 1(*b*) and would not be able to access any other program, including the client application program, until the Note Pad external application program had been closed down. Particularly in a windowing operating system such as Microsoft Windows, in which a user expects to be able to access any application program at any time, this is a significant limitation.

Accordingly, there is a need to provide a managing system for managing external applications associated with compound documents in which the management system provides a user with flexibility like that provided in an OLE-based implementation while at the same time does not require specialized communication between the client application program and the external application program.

SUMMARY OF THE INVENTION

The present invention addresses the aforementioned need in the art by providing a managing system which manages external applications that are launched from compound documents displayed in a client application without the need for specialized communication between the client application and the external applications.

In one aspect, the management system of the present invention includes an external application manager and an external file manager, both of which are instantiated by a client application program which supports compound documents. The external application manager determines which external application to launch based on characteristics in a file name provided from the client application, such as the DOS extension to the file name, launches the external application with the file, returns a pointer for the external application to the client application, periodically polls for activity of the external application, and outputs the file name to the external file manager. The external file manager monitors the file to determine if the file has been modified by the external application. Modification information is provided via the application manager back to the client application.

Because the external application manager simply monitors the external application (by polling), and the external file manager likewise only monitors the external file, there is no need for specialized communication between the client application and the external application. Moreover, because the external application is launched using a windowing operating system, the user is free to switch between any of the applications, including the client application. Thus, for example, if the external application is no longer in focus when the user re-selects the external data object from the client application display, the client-application simply refers to pointers returned from the application manager to determine whether there is an existing application program corresponding to the external object. If there is, then the client application requests application manager to put the external application in focus, and the application manager in turn asks the windowing operating system to activate the window of the external application so as to put the external application in focus. If there is no pointer, then the client application simply requests the application manager and file manager to launch a suitable external application.

Likewise, when an external application is closed down, the application manager which has been monitoring the activity of external applications advises the client application of this fact. The client application then decides based on the monitoring activities of the file manager whether it is necessary to re-import a file that has been modified by an external application.

In like manner, when the client application is closed down or iconized, the client application can easily determine whether there are any external applications by referring to the pointers returned by the application manager. If the client application is being closed down, then it can prompt the user to close down all external applications prior to closing down; as the external applications are closed, the client application can re-import any modified files as described previously. On the other hand, if the client application is being iconized, then the client application can sweep all external applications down into a single icon for the client application.

Accordingly, the invention as described above provides a full featured and robust implementation of compound documents which does not require a client application to communicate with external applications.

This brief summary has been provided so that the nature of the invention may be understood quickly. A more complete understanding of the invention can be obtained by reference to the following detailed description of the preferred embodiment thereof in connection with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1**(*a*), **1**(*b*) and **1**(*c*) illustrate how a compound document appears to a user of a client application program.

FIG. **2** is a view for showing the outward appearance of a representative embodiment of the present invention.

FIG. **3** is a detailed block diagram showing the internal construction of computing equipment shown in FIG. **2**.

FIG. **4** is a block diagram showing the structure of the managing system of the present invention.

FIGS. **5**(*a*), **5**(*b*) are flow diagrams illustrating operation of the managing system shown in FIG. **4**.

FIG. **6** is an illustrative view of a compound document.

FIG. **7** is a detailed flow diagram showing polling by the application tracker.

FIG. **8** is a flow diagram showing the procedure for closing down or iconizing a client application.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **2** is a view showing the outward appearance of a representative embodiment of the present invention. Shown in FIG. **2** is computing equipment **20** such as an IBM PC or PC-compatible computer having a windowing operating system such as a Microsoft Windows operating system. Computing equipment **20** is provided with a display monitor **23** having a display screen **22** on which computing equipment **20** displays images to the user. Computing equipment **20** is further provided with a floppy disk drive **24** with which removable floppy disk media may be read or written, fixed disk drive **25** for storing data files and application program files, a keyboard **26** for permitting input of text data and manipulation of objects displayed on display screen **22**, a pointing device **27** such as a mouse or the like which is also provided to permit manipulation of objects on display screen **22**, and a combined speaker/microphone **29**. A conventional printer **30** as well as connections to a network **31** or to an ordinary voice telephone line **32** for sending and receiving voice and/or facsimile messages are also provided.

In accordance with operator instructions, and under control of the windowing operating system, stored application programs such as client application programs and external application programs are selectively activated to process and manipulate data.

FIG. **3** is a detailed block diagram showing the internal construction of computing equipment **20**. As shown in FIG. **3**, computing equipment **20** includes a central processing unit (CPU) **40** such as programmable microprocessor interfaced to a computer bus **41**. Also interfaced to computer bus **41** is speaker/microphone interface **42**, display interface **44**, network interface **45**, fax/modem/telephone interface **46**, printer interface **47**, and floppy disk drive interface **49**.

Main memory **51** such as random access memory (RAM) interfaces to computer bus **41** so as to provide CPU **40** with access to memory storage. In particular, when executing stored application program instruction sequences such as those associated with application programs stored on disk **25**, CPU **40** loads those instruction sequences from disk **25** (or other storage media such as media accessed via network **31**) into main memory **51** and executes those stored program instruction sequences out of main memory **51**.

ROM (read only memory) **52** is provided for storing invariant instruction sequences such as start-up instruction sequences or basic input/output operating system (BIOS) sequences for operation of keyboard **26**.

As shown in FIG. 3, and as previously mentioned, fixed disk 25 stores program instruction sequences for the windowing operating system and for various application programs such as a message manager application program, a graphics application program, a sound application program, and the like. In addition, stored on fixed disk 25 are compound document files together with other data files such as data files associated with the application programs. Fixed disk 25 also stores the management system of the present invention which, as shown in FIG. 3, is comprised by two components: an external application manager and an external file manager. Both components are instantiated by a client application that requires managing of external applications and their associated files. The structure of the external application and file managers is described in connection with FIG. 4, and its operation is described in the flow diagrams in FIGS. 5, 7 and 8.

More particularly, FIG. 4 shows client application 55 with instantiations of application manager 60 and file manager 70. Application manager 60 includes application pool manager 61, application tracker 62, application launcher 64, application finder 65, and application browser 66. FIG. 4 shows application manager 60 as containing three application entry objects, namely objects 67, 68 and 69. As will be described more fully below, one such object is provided for each external application, such as applications 87, 88 and 89. It will therefore be understood that the provision of three application entry items is illustrative only, and that typically upon instantiation of application manager 60 there will not be any application entry objects until client application 55 requests application manager 60 to launch such an external application.

File manager 70 includes file pool manager 71, and file tracker 72. In addition, FIG. 4 shows file manager 70 as including three file entry objects, namely objects 77, 78 and 79, one each for each of external files such as files 97, 98 and 99. As before with respect to application entry objects 67, 68 and 69, one file entry object is provided for each external file. Thus, although FIG. 4 shows three such objects, upon instantiation of file manager 70 there will ordinarily not be any file entry objects.

The functional capabilities of each object shown in FIG. 4 will now be explained.

Application pool manager 61 is a holder for all application entry objects and has the capability of creating, adding, removing and managing those objects. Application pool manager 61 communicates with client application 55 by receiving requests from client application 55 to create entry objects and by sending to client application 55 pointers for application entry objects. Application pool manager 61 also communicates with file pool manager 71 by providing file pool manager 71 with file names and by receiving file pointers from file pool manager 71.

Application tracker 62 is responsible for checking for existence of all external applications and for synchronizing itself with the status of those external applications. As described more fully below, application tracker 62 operates on a periodic polling basis, namely by sending polling requests to application finder 65 and to file tracker 72. In situations where application finder 65 advises application tracker 62 that a particular external application no longer exists, application tracker 62 advises application pool manager 61 of the new application status. In that case, the application pool manager 61 removes the appropriate application entry object and, in turn, updates client application 55's list of pointers. File tracker 72 responds to polling requests from application tracker 62 by advising application tracker 62 of the status of external files, specifically whether such external files have been modified or not. In the event that external files have been modified, application tracker 62 advises application pool manager 61 of that fact and application pool manager 61, in turn, updates client application 55.

Application launcher 64 is used to launch an external application. Application launcher 64 communicates with client application 55 through receipt of a data object. Ordinarily, the data object is a file name received from client application 55 in response to user selection of a data object in a compound document. In that case, application launcher 64 determines whether there is an external application associated to the file name. If there is an external application associated with the file name application launcher 64 launches that application. To find associated applications, application launcher 64 issues requests to the windowing operating system for associated applications. If the windowing operating system cannot identify the application, application launcher 64 tries to identify an associated application through other means, such as searching through initialization (.INI) files. If an application is successfully launched, application launcher 64 advises client application 55 of a successful launch. Otherwise, application launcher 64 advises client application 55 that no application was launched.

Application browser 66 is invoked by client application 55 in the event that an external application cannot be associated to a data object provided to application launcher 64. If invoked, application browser 66 provides the user with a display of available application programs and permits the user to select one. If an application is selected, application browser 66 provides the selected application to client application 55 which, in turn, provides it to application launcher 64.

Application entry objects, such as objects 67, 68 and 69, contain all related information for applications such as the task handle for the application, the instance handle for the application, the window handle of the application, and the owner of the application (here, an item within client application 55). As mentioned above, one application entry object is provided for each external application.

Application finder 65 is responsible for finding previously-launched external applications and assuring that any external applications so found are actually present. In particular, because of timing delays and system overhead, it is possible to incorrectly conclude that an application is present when in fact it no longer exists. To assure that an external application is actually present, application finder 65 obtains the application window handle and the application task handle. Application finder 65 then matches the application instance handle in the application entry object against the application instance handle obtained from the window handle, and matches the application task handle in the application entry object against the application task handle obtained from the window handle. If both match, application finder 65 concludes that an application which the windowing operating system indicates is present is actually present, and advises application tracker 62 of that in response to polling requests.

File pool manager 71 holds all file entry objects and has the capability of creating, adding, removing and managing those objects. File pool managers 71 communicates with application pool manager 61 by receiving file names from application pool manager 61. In response to receipt of a file

name, file pool manager **71** opens a file entry object, and returns a file pointer to the application pool manager.

File tracker **72** checks for existence of all files in the file pool and determines when a file has been modified. When it detects modification of a file, file tracker **72** advises application tracker **62** of that fact in response to a polling request.

File entry objects, such as objects **77**, **78** and **79**, contain all related information for a file such as the file name, a time stamp and possible persistent storage identifiers. As mentioned above, file pool manager **71** creates only one file entry object for each file.

By virtue of the above-described structure of application manager **60** and file manager **70**, it will be appreciated that a full-featured external application and file management system has been provided which does not need to communicate with any external application or any external file. Rather, to provide full management of external applications and files, the application manager and file manager need only check pointers and handles provided by the windowing operating system.

FIG. **5** is a flow diagram illustrating operation of the FIG. **4** managing system. The steps performed in FIG. **5** are executed by CPU **30** in accordance with stored program instruction sequences stored on fixed disk **25** and executed out of random access memory **51**.

In step **S501**, the user activates the client application which, as part of its initialization routine, instantiates the application manager **60** and file manager **70**. In step **S502**, application tracker **62** commences polling of application finder **65** and file tracker **72** to determine the status of any existing external applications as well as whether or not files associated with those external applications have been modified. Polling is described in fuller detail in connection with FIG. **7**; for present purposes, it is sufficient to note that polling occurs on a periodic basis which is set to between three and ten seconds.

In step **S503**, the user utilizes client application **55** to create a compound document, such as the compound document shown in FIG. **6**. More particularly, in the representative embodiment of the invention described here, the client application is a message manager application program. To build a compound document, the user selects the message builder option button **101** from tool bar **100**, which causes the message manager application to display a message builder screen **102**. After entering data in the native message manager application mode, the user is permitted to attach documents created by external applications, thereby creating a compound document. In particular, by selecting attach button **105**, screen **106** is displayed to allow a user to embed a document or form a link to the document. In the case of embedding a document, a copy of the document is physically created within the compound document, whereas in the case of a linked document, only a link to the external document is stored. The option of linking or embedding is provided by radio button **103***a* and **103***b*. After selecting whether to link or to embed the external document, a compound document such as that shown in display area **104** is created.

In step **S504**, the client application displays the compound document and allows user selection of any external object (or data item) from the compound document. In step **S505**, in response to user selection of a data item, client application **55** checks if there is a valid pointer, previously supplied from application pool manager **61**, for the entry object for this item (**S506**). If there is a valid pointer, then the user has previously activated this data item and there is a corresponding external application which is present. Accordingly flow branches to step **S507** in which client application **55** merely passes the window handle to the windowing operation system which, in turn, puts the external application into focus for use by the user. Flow then advances to step **S519** in which the windowing operating system displays a window for the selected external application.

Presumably, however, if this is the first time that the item has been selected by the user, then there is no valid pointer for an entry object for this item. Accordingly, flow continues to step **S508** in which the client application creates a temporary file for use by the external application. In more detail, in a case where the item is a linked item, client application **55** simply uses the file designated by the link. If, on the other hand, the selected item is an embedded item, then client application **55** creates a temporary file and stores the embedded data from the compound document into the temporary file. When creating the temporary file, client application **55** maintains the same DOS extension for the file name. As will be seen below, the DOS extension is used as a key to associate particular external application programs with the temporary file. For example, a .BMP extension is presumed to be a bitmap file and an external graphics application such as Microsoft Paint Brush which handles bitmap files, is associated with a .BMP file. Likewise, a .TXT file is presumed to be a text file and a text editor such as Microsoft Note Pad is associated with such a file; and a .WAV file is assumed to be a wave file and a sound editor such as Microsoft Sound Recorder is associated with such a file. Similar associations are well known to those skilled in the art.

In step **S509**, client application **55** invokes application launcher **64** to determine whether an external application can be associated with the temporary file (or, for a linked item, the linked file). Application launcher **64** inspects the DOS extension of the file name and determines whether an external application can be associated with that DOS extension. In making this determination, application launcher **64** refers to the windowing operating system and, in the case where the windowing operating system cannot return an external application, also refers to initialization files such as .INI files which store such associations. If an association is not found (step **S510**), then flow advances to step **S511** in which application launcher **64** returns an error code to client application **55**. Client application **55** then invokes application browser **66** (step **S512**) which allows a user to make a manual selection of an external application (step **S513**). The manual selection is returned by application browser **66** to client application **55** which, in turn, returns the manually-selected application to application launcher **64**.

In the case where application launcher **64** is able to associate an external application file to the DOS extension, or in the case of manual designation by the user in step **S513**, application launcher **64** launches the associated external application. For example in the case of a .BMP file, application launcher **64** may launch a Paint Brush application as seen at **87**. Similarly, in the case of a .TXT file, application launcher **64** launches a Note Pad application **88**; or in the case of a .WAV file, application launcher **64** launches sound recorder external application **89**. Application launcher then informs client application **55** that an external application has successfully been launched (step **S515**).

Upon learning of successful launch of an external application, client application **55** invokes application pool manager **64** to create an application entry object corresponding to the launched application. Application pool manager **61** responds by creating an application entry object such as

object **67**, **68** or **69**, the application entry object being responsible to store information concerning the application. As mentioned previously, one application entry object is created for each existing external application (or in the case where two different files in the same compound document have the same DOS extension, for each separate instance of the external application).

Application pool manager **61** further invokes file pool manager **71** to create a corresponding file entry object (step S517). In like manner to the application pool manager, the file pool manager **71** creates a file entry object, such as object **77**, **78** or **79**, to track the status of the temporary file with which the newly-launched external application is operating.

Flow then advances to step **S518** in which application pool manager returns a pointer to the client application. The pointer is a pointer for the application entry object and the file entry object. The client application **55** is able to use this pointer for future operations, such as in step **S506** where the client application determines whether there is a valid pointer signifying that an external application is present for a selected item, or such as described below in connection with closing down or iconizing of client application **55**. Flow then advances to step **S519** in which the windowing operating system displays a window for the selected external application.

Thereafter, the user is free to use the newly-launched external application to create, edit or otherwise modify the data item from the compound document. In addition, the user is free to switch focus to other windows or to activate new windows. When the user wishes to return to the window corresponding to the external application, he can do so through normal windowing protocol or he may re-select the data item from a compound document displayed by client application **55**. In that case flow proceeds as described above in connection with step **S506** in which client application **55** determines whether there is a valid pointer for the entry object corresponding to the selected item and in which, in response to a positive identification of such a valid pointer, client application **55** simply passes the window handle to the windowing operating system which executes focus onto the external application.

FIG. **7** is a detailed flow diagram showing polling by application tracker **62**.

In step **S701**, application tracker **62** invokes file tracker **72** which, via any existing file entry objects, determines whether a file has been modified. If file tracker **72** determines from a file entry object that an external file has been modified (step **S702**) then flow branches to step **S703** in which file tracker **72** advises application tracker **62** that a particular file has been modified. That information is passed from application tracker **62** to application pool manager **61** which, in turn, advises client application **55** that a particular file corresponding to one file entry object has been modified.

In either event, flow advances to step **S704** in which application tracker **62** invokes application finder **65** to determine whether each external application corresponding to an application entry object is still present. Using the above-described procedure of matching windows handles and instance handles to task handles, application finder **65** checks to ensure that all external applications corresponding to application entry objects are still present. So long as the tested handle values match (step **S706**), then application finder **65** determines that each external application is still present and returns that information to application tracker **62** (step **S707**). Then, after a predetermined period (such as three to ten seconds), application tracker **62** repeats its polling process (step **S708**).

On the other hand, if in step **S706** application finder **65** determines that there is no match for the tested handle values, then application finder **65** concludes that an external application has been closed down. Flow then advances to step **S709** in which close down procedures are carried out. Particularly, as shown in step **S710**, application tracker **62** advises application pool manager to remove an application entry object corresponding to the closed down external application. In step **S711**, the closed down application entry object updates application finder **65** with its new closed down status and then closes itself down. Then in step **S712**, application pool manager **61** invokes file pool manager **71** to remove its corresponding file entry object. In response, in step **S713**, the file entry object (or objects) determines if the temporary file created in step **S508** was modified by the external application. If no modification had taken place, then client application **55** simply destroys the temporary file. On the other hand, if modifications have taken place, then client application **55** re-imports the data in the temporary file into its internal compound document In addition, client application **55** updates any parameters affected by the re-imported file, such as parameters giving an indication to the user as to size and/or date of most recent modification of the file. In step **S714** application pool manager **61** advises client application **55** that the external application has closed down.

FIG. **8** is a flow diagram showing the procedure in a case where the user has selected close down or iconization of client application **55**. More particularly, as is generally known, it is possible for the user to request the windowing operating system to close down client application **55**, for example, by double clicking on control button **107** shown in FIG. **6**. Likewise, it is possible for a user to request the windowing operating system to iconize the client application, for example by clicking on minimize button **108**. When close down is requested, the windowing operating system exits client application **55** and frees memory previously used by that application. If iconization is selected, the windowing operating system removes all windows associated with client application **55** from display screen **22** and replaces all those windows with an icon representing the client application The user may re-invoke all windows associated with client application **55** by double clicking the application icon.

The flow process shown in FIG. **8** ensures that upon close down or iconization of client application **55**, corresponding external applications are closed down in an orderly procedure or swept into the icon for client application **55**. More particularly, as shown in step **S801**, upon user selection of close down or iconization, client application **55** determines whether there are any external applications present. Client application **55** makes this determination by reference to its list of pointers for entry objects which was provided by application pool manager. If no external applications exist (step **S802**), flow branches to step **S803** in which client application **55** is simply closed down or iconized, as requested by the user.

If, on the other hand, there are any existing external applications, then flow advances to step **S804** in which, if a close down operation has been requested, flow advances to step **S805** where client application **55** requests the user to close down the external applications. A dialog box may be provided to warn the user of the existence of external applications. As each external application is closed down, the close down procedures commencing at step **S709** are followed, after which flow advances to step **S806** in which client application **55** is closed down.

If step **S804** determined that an iconize operation had been requested, then flow advances to step **S807** in which client application **55** provides the windowing operating system with the window handle to each external application and requests the windowing operating system to de-display that window. After all external applications have had their windows de-displayed, flow advances to step **S808** in which client application **55** is reduced to an icon. In response to a user request to restore client application **55** (step **S809**) such as by double clicking on the iconic representation of client application **55**, the windowing operating system re-displays the client application **55** (step **S810**). After the client application **55** has been re-displayed, it, in turn, provides the windowing operating system with pointers for all external applications. Using those windows pointers, the windowing operating system re-displays the external applications.

What is claimed is:

1. A computer implemented system for managing an external application in response to user selection of an item in a compound document displayed from a client application, said computer implemented system comprising:

an application manager which receives a file name for an external file corresponding to the item selected from the compound document and which, based on the file name, associates an external application to the external file, launches the external application, repetitively polls for information regarding the external application, and outputs the file name, wherein the information polled for at least includes information concerning existence of the external application; and

a file manager, responsive to outputting of the file name from the application manager, which monitors the external file to determine if the external file has been modified by the external application and which returns to the application manager a pointer for the external file;

wherein the application manager returns a pointer for the external application and a pointer for the external file to the client application.

2. A computer implemented system according to claim **1**, wherein the client application responds to user selection of an item in the compound document by copying the selected item to a temporary file and by sending the temporary file name to the application manager, and wherein in response to receipt of the pointers from the application manager, the client application instructs a windowing operating system to display a window for the external application.

3. A computer implemented system according to claim **1**, wherein the client application responds to user selection of an item in the compound document by determining if a valid pointer for the selected item has been received from the application manager, and wherein in a case where a valid pointer exists the client application instructs a windowing operating system to display a window for the external application, and wherein in a case where a valid pointer does not exist the client application copies the selected item to a temporary file, sends the temporary file name to the application manager, and in response to receipt of a pointer from the application manager, instructs the windowing operating system to display a window for the external application.

4. A computer implemented system according to claim **1**, wherein in response to close down of an external application, said application manager invalidates the pointer sent to the client application.

5. A computer implemented system according to claim **1**, wherein in response to close down of the client application, the client application inspects valid pointers received from the application manager to determine whether any external applications are still present, and before closing down requests close-down of still-present external applications.

6. A computer implemented system according to claim **1**, wherein in response to iconization of the client application, the client application inspects valid pointers received from the application manager to determine whether any external applications are still existing and instructs a windowing operating system to de-display any still-existing external applications before iconization.

7. A computer implemented system according to claim **1**, wherein information polled for includes a window handle for the external application and a task handle for the external application, and wherein said application manager determines whether the external application is present by matching the window handle and the task handle against corresponding window and task handles in an entry object for the external application.

8. A computer implemented system according to claim **4**, wherein in response to close down of an external application, the external file manager determines whether the external file has been modified, and in a case where the external file has been modified re-imports data from the external file.

9. A computer implemented system according to claim **7**, wherein in response to restoration of an iconized client application, the client application inspects valid pointers received from said application manager and instructs the windowing operating system to re-display any still-present external applications.

10. A computer implemented system for managing an external application in response to user selection of an item in a compound document displayed by a client application, said computer implemented system comprising:

a windowing operating system for displaying windows;

a client application, interacting with said windowing operating system which creates, retrieves and stores compound documents and displays compound documents for user selection of an item therein, wherein in response to user selection of an item in the compound document said client application copies the selected item to an external file and outputs an external file name for the external file;

an application manager instantiated by said client application, said application manager including (a) an application tracker which repetitively outputs polling requests to check for existence of previously-launched external applications, (b) an application finder responsive to polling requests from the application tracker which returns to the application tracker information on whether an external application is present, (c) an application pool manager for creating, adding and removing application entry objects, the application pool manager also for receiving the external file name from the client application and outputting it, and for returning a pointer for the external file and the external application to the client application, and (d) an application launcher which associates an external application to the external file name output by said client application and which launches the external application; and

a file manager, instantiated by the client application, said file manager including (i) a file tracker responsive to polling requests from the application tracker to check for modification of the external file created by the client application returning information on file modifications to the application tracker, and (ii) a file pool manager for creating, adding and removing a file entry object

corresponding to the external file, the file pool manager being responsive to output of the external file name from the application pool manager by creating a file entry object.

11. A computer implemented system according to claim **10**, wherein in response to output of the pointer for the external file and external application, the client application instructs the windowing operating system to display a window for the external application.

12. A computer implemented system according to claim **10**, wherein the client application responds to user selection of an item in the compound document by determining if a valid pointer for the selected item has been received from the application manager, and wherein in a case where a valid pointer exists the client application instructs a windowing operating system to display a window for the external application.

13. A computer implemented system according to claim **10**, wherein in response to close down of an external application, said application manager invalidates the pointer sent to the client application.

14. A computer implemented system according to claim **10**, wherein in response to close down of the client application, the client application inspects valid pointers received from the application manager to determine whether any external applications are still present, and before closing down requests close-down of still-present external applications.

15. A computer implemented system according to claim **10**, wherein in response to iconization of the client application, the client application inspects valid pointers received from the application manager to determine whether any external applications are still present and instructs a windowing operating system to de-display any still-present external applications before iconization.

16. A computer implemented system according to claim **10**, wherein said application finder confirms that an external application is still present by testing the external application window handle, the external application task handle, matching the external application instance handle against the external application window handle, and matching the external application task handle against the external application window handle.

17. A computer implemented system according to claim **10**, wherein information polled for includes a window handle for the external application and a task handle for the external application, and wherein said application manager determines whether the external application is present by matching the window handle and the task handle against corresponding window and task handles in an entry object for the external application.

18. A computer implemented system according to claim **13**, wherein in response to close down of an external application, the external file manager determines whether the external file has been modified, and in a case where the external file has been modified re-imports data from the external file.

19. A computer implemented system according to claim **15**, wherein in response to restoration of an iconized client application, the client application inspects valid pointers received from said application manager and instructs the windowing operating system to re-display any still-present external applications.

20. A computer implemented method for managing an external application in response to user selection of an item in a compound document displayed from a client application, said method comprising the steps of:

instantiating an application manager which repetitive commences polling operations to determine whether previously-launched external applications are present and whether associated external files have been modified;

instantiating a file manager responsive to polling requests from the application manager to determine whether an external file has been modified and to inform the application manager of same;

displaying a compound document from a client application;

responding to user selection of an item in the compound document by creating an external file corresponding to the selected item, outputting a file name corresponding to the selected item to the application manager, associating an external application to the file name, launching the external application, and returning, to the client application, a pointer for the external file and the external application.

21. A method according to claim **20**, further comprising the step of responding to receipt of the pointer for the external file and the external application by instructing a windowing operating system to display a window for the external application.

22. A method according to claim **20**, wherein said step of responding to user selection of an item in the compound document includes the steps of determining if a valid pointer for the selected item has been received from the application manager, instructing the windowing operating system to display a window for the external application in the case where a valid pointer exists, and sending an external file name to the application manager in a case where a valid pointer does not exist.

23. A method according to claim **20**, further comprising the step of responding to close down of the external application by invalidating the pointer sent to the client application.

24. A method according to claim **20**, further comprising the steps of responding to close down of the client application by inspecting pointers received from the application manager to determine whether any external applications are still present, and requesting close-down of still-present external applications before closing down the client application.

25. A method according to claim **20**, further comprising the steps of responding to iconization of the client application by inspecting the pointers received from the application manager to determine whether any external applications are still present and instructing the windowing operating system to de-display any still-present external applications before iconizing.

26. A computer implemented method according to claim **20**, wherein information polled for includes a window handle for the external application and a task handle for the external application, and wherein said application manager determines whether the external application is present by matching the window handle and the task handle against corresponding window and task handles in an entry object for the external application.

27. A method according to claim **23**, further comprising the step of re-importing external file data to the compound document in a case where the external file has been modified.

28. A method according to claim **25**, further comprising the step of responding to restoration of the iconized client application by inspecting pointers received from the application manager and instructing the windowing operating system to re-display any still-present external applications.

29. An apparatus for managing an external application in response to user selection of an item in a compound document displayed from a client application, said apparatus comprising:

a display for displaying compound documents and windows corresponding to the client application and external applications;

a memory for storing program steps corresponding to a windowing operating system which responds to instructions to display the client application and external applications on said display, and for storing program instruction sequences corresponding to the client application; and

a processor for executing the stored program instruction sequences in said memory,

wherein said stored program instruction sequences include steps to (a) instantiate an application manager which commences repetitive polling operations to determine whether previously-launched external applications are present and whether associated external files have been modified, (b) instantiate a file manager responsive to polling requests from the application manager to determine whether an external file has been modified and to inform the application manager of same, (c) display a compound document from a client application, and (d) respond to user selection of an item in the compound document by creating an external file corresponding to the selected item, outputting a file name corresponding to the selected item to the application manager, associating an external application to the file name, launching the external application, and returning, to the client application, a pointer for the external file and the external application.

30. An apparatus according to claim 29, wherein said stored program instruction sequences further include steps to respond to receipt of the pointer for the external file and the external application by instructing the windowing operating system to display a window for the external application.

31. An apparatus according to claim 29, wherein said stored program instruction sequences to respond to user selection of an item in the compound document further include steps to determine if a valid pointer for the selected item has been received from the application manager, instruct the windowing operating system to display a window for the external application in the case where a valid pointer exists, and send an external file name to the application manager in a case where a valid pointer does not exist.

32. An apparatus according to claim 29, wherein said stored program instruction sequences further include steps to respond to close down of the external application by invalidating the pointer sent to the client application.

33. An apparatus according to claim 29, wherein said stored program instruction sequences further include steps to respond to close down of the client application by inspecting pointers received from the application manager to determine whether any external applications are still present, and requesting close-down of still-present external applications before closing down the client application.

34. An apparatus according to claim 29, wherein said stored program instruction sequences further include steps to respond to iconization of the client application by inspecting the pointers received from the application manager to determine whether any external applications are still present and instructing the windowing operating system to de-display any still-present external applications before iconizing.

35. An apparatus for managing an external application according to claim 29, wherein information polled for includes a window handle for the external application and a task handle for the external application, and wherein said application manager determines whether the external application is present by matching the window handle and the task handle against corresponding window and task handles in an entry object for the external application.

36. An apparatus according to claim 32, wherein said stored program instruction sequences further include steps to re-import external file data to the compound document in a case where the external file has been modified.

37. An apparatus according to claim 34, wherein said stored program instruction sequences further include steps to respond to restoration of the iconized client application by inspecting pointers received from the application manager and instructing the windowing operating system to re-display any still-present external applications.

38. Computer-executable process steps stored on a computer-readable medium to manage an external application in response to user selection of an item in a compound document displayed from a client application, the process steps including:

a first instantiation step which instantiates an application manager which commences repetitive polling operations to determine whether previously-launched external applications are present and whether associated external files have been modified;

a second instantiation step which instantiates a file manager responsive to polling requests from the application manager to determine whether an external file has been modified and to inform the application manager of same;

a displaying step which displays a compound document from a client application;

a responding step which responds to user selection of an item in the compound document by creating an external file corresponding to the selected item, outputting a file name corresponding to the selected item to the application manager, associating an external application to the file name, launching the external application, and returning, to the client application, a pointer for the external file and the external application.

39. Computer-executable process steps according to claim 38, further comprising a step which responds to receipt of the pointer for the external file and the external application by instructing a windowing operating system to display a window for the external application.

40. Computer-executable process steps according to claim 38, wherein said responding step includes a determining step which determines if a valid pointer for the selected item has been received from the application manager, instructs the windowing operating system to display a window for the external application in the case where a valid pointer exists, and sends an external file name to the application manager in a case where a valid pointer does not exist.

41. Computer-executable process steps according to claim 38, further comprising a step which responds to close down of the external application by invalidating the pointer sent to the client application.

42. Computer-executable process steps according to claim 38, further comprising a step which responds to close down of the client application by inspecting pointers received from the application manager to determine whether any external applications are still present, and which requests close-down of still-present external applications before closing down the client application.

43. Computer-executable process steps according to claim 38, further comprising a step which responds to iconization

of the client application by inspecting the pointers received from the application manager to determine whether any external applications are still present and instructing the windowing operating system to de-display any still-present external applications before iconizing.

44. Computer-executable process steps according to claim **38**, wherein information polled for includes a window handle for the external application and a task handle for the external application, and wherein said application manager determines whether the external application is present by matching the window handle and the task handle against corresponding window and task handles in an entry object for the external application.

45. Computer-executable process steps according to claim **43**, further comprising a step which responds to restoration of the iconized client application by inspecting pointers received from the application manager and instructing the windowing operating system to re-display any still-present external applications.

46. Computer-executable process steps according to claim **41**, further comprising a step which re-imports external file data to the compound document in a case where the external file has been modified.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,922,054

DATED : July 13, 1999

INVENTOR(S) : Farzad Bibayan

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1, line 18, change "Compound," to --Compound--.

Column 2, line 12, change "application s " to --application.--; and
line 44, delete "a".

Column 6, line 65, change "managers" to --manager--.

Column 12, line 24, change "claim 7," to --claim 6,--.

Column 14, line 1, change "repetitive" to --repetitively--; and
line 38, change "steps" to --step--.

Signed and Sealed this

Twenty-first Day of November, 2000

Attest:

Q. TODD DICKINSON

Attesting Officer

Director of Patents and Trademarks